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IS 1180-2 (1989): Outdoor type three-phase distribution transformers up to and including 100 kVA 11 kV, Part 2: Sealed type [ETD 16: Transformers]



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*Indian Standard*

**OUTDOOR TYPE THREE-PHASE DISTRIBUTION  
TRANSFORMERS UP TO AND INCLUDING  
100 kVA 11 kV — SPECIFICATION**

**PART 2 SEALED TYPE**

*( First Revision )*

**भारतीय मानक**

**बाहरी टाइप तीन फेसी वितरण ट्रांसफार्मर 100 कि वो ए  
11 कि वो तक के लिए — विशिष्ट**

**भाग 2 सील वाले**

**( पहला पुनरीक्षण )**

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**BUREAU OF INDIAN STANDARDS  
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NEW DELHI 110002**

April 1990

Price Group 2

## FOREWORD

This Indian Standard (Part 2) (First Revision) was adopted by the Bureau of Indian Standards on 30 May 1989, after the draft finalized by the Transformers Sectional Committee had been approved by the Electrotechnical Division Council.

Sealed type construction for distribution transformers has been developed in view of difficulties in proper maintenance of a large number of conventional transformers installed in the vast and scattered rural areas as well as the reduction in the maintenance cost.

This standard was originally published in 1979. This revision has been undertaken to take into account the experience gained since then.

The major changes in this revision include the reduction of limits of no load and load losses and the modification of terminal arrangement and temperature rise for top oil, in line generally with REC Specification on the subjects.

In this standard, for various common requirements, references have been made to IS 2026 'Specification for power transformers' which is, therefore, a necessary adjunct to this standard.

The requirements of non-sealed type outdoor distribution transformers of similar voltage and kVA ratings are covered in Part 1 of this standard.

This standard is intended to cover the technical provisions relating to transformers and it does not include all the necessary provisions of a contract.

In the preparation of this standard, assistance has been derived from REC Specification 11/1976 'Outdoor type three phase, 11 kV/433-250 V sealed distribution transformers up to and including 100 kVA, issued by the Rural Electrification Corporation Ltd.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# OUTDOOR TYPE THREE-PHASE DISTRIBUTION TRANSFORMERS UP TO AND INCLUDING 100 kVA 11 kV — SPECIFICATION

**PART 2 SEALED TYPE***( First Revision )***1 SCOPE**

1.1 This standard (Part 2) specifies the requirements and tests for oil immersed, naturally air-cooled, three-phase, double-wound outdoor distribution transformers of sealed tank construction up to and including 100 kVA, for use on nominal system voltages up to and including 11 kV.

**2 REFERENCES**

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

**3 TERMINOLOGY**

3.1 For the purpose of this standard, the following definitions, in addition to those given in IS 1885 (Part 38) : 1977 shall apply.

**3.1.1 Sealed Transformers**

A transformer which is non-breathing, that is, so sealed that there can be no interchange between its contents and the external atmosphere.

**3.1.2 Type Tests**

Tests carried out to prove conformity with the requirements of the standard. These tests are intended to assess the general quality and design of a given type of transformer.

**3.1.3 Routine Tests**

Tests carried out on each transformer to check the requirements which are likely to vary during production.

**4 SERVICE CONDITIONS**

4.1 The provisions of 4 of IS 2026 (Part 1) : 1977 shall apply.

**5 RATINGS****5.1 kVA Ratings**

The standard ratings shall be 16, 25, 63 and 100 kVA.

**5.2 Rated Frequency**

The rated frequency shall be 50 Hz.

**5.3 Nominal System Voltage**

Nominal system voltage shall be chosen from the following:

3.3, 6.6 and 11 kV

**6 NO-LOAD VOLTAGE RATIOS**

6.1 The no-load voltage ratios shall be as follows:

3 300/433-250, 6 600/433-250 or 11 000/433-250

NOTE — An alternative no-load voltage ratios of 10 450/433-250 is also permissible for 11 kV systems.

**7 WINDING CONNECTIONS AND VECTORS**

7.1 The primary winding shall be connected delta and the secondary winding star [ vector symbol Dyn 11 in accordance with IS 2026 (Part 4) : 1977 ], so as to produce a positive phase displacement of 30° from the primary to the secondary vectors of the same phase. The neutral of the secondary winding shall be brought out to a separate insulated terminal.

**8 TAPS**

8.1 No taps are required to be provided on these transformers.

**9 TRANSFORMER TANK****9.1 Construction**

9.1.1 The transformer tank shall be of adequate strength to withstand positive and negative pressures built up inside the tank while the transformer is in operation. The transformer tank covers shall be welded with tank rim so as to make a leak-proof joint.

**9.2 Tank Sealing**

9.2.1 The space above the oil-level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747 : 1972.

9.2.2 Dry air/nitrogen plus oil volume inside the tank shall be such that even under the extreme operating conditions the pressure generated inside the tank does not exceed 40 kPa positive or negative.

**9.2.3** The oil level before sealing the transformer shall be made up to the required level while the transformer filled with oil is maintained at a temperature of 45°C. Alternatively the tank may be sealed at any other temperature and free-oil level adjusted to meet the requirement of 9.2.2.

**9.3** The transformer cover and frame shall be such that it is possible to remove the weld and reweld twice.

## 10 TRANSFORMER OIL

**10.1** The transformer oil shall comply with the requirements of IS 335 : 1983.

NOTE — Inhibited oil may be used subject to agreement between the purchaser and the manufacturer.

## 11 FITTINGS

**11.1** The following fittings shall be provided on each transformer:

- a) To earthing terminals with the symbol  $\perp$  ,
- b) Lifting lugs for the complete transformer as well as for core and winding,
- c) Rating and terminal making-plate,
- d) Nitrogen/air filling device/pipe with welded cover capable of reuse,
- e) An extended pipe connection on upper end with welded cover. The pipe should be suitably threaded over a sufficient length to enable use of a refilling/syphon connection after removing the welded cover or any other similar arrangement capable of reuse,
- f) A bottom connection as in (e) may be provided subject to agreement between the manufacturer and the purchaser, and
- g) Oil level gauge ( optional ).

## 12 TERMINAL ARRANGEMENT

**12.1** The transformers shall be fitted on high voltage and low voltage sides with outdoor type bushings of appropriate voltage and current ratings. The high voltage bushings shall conform to IS 2099 : 1986. The low voltage bushings shall conform to IS 7421 : 1974. Alternatively the low voltage side may be made suitable for adoption of PVC cable of suitable size.

**12.2** The terminal arrangements shall be such that it shall be possible to replace the bushings (external) without opening the cover and also without affecting the sealing of the transformer. The arrangement shall meet the following requirements:

### a) HV Bushing

The bushing shall be made in two parts. The outer bushing shall be of porcelain. The dimensions of the outer bushing shall conform to IS 3347 ( Part 3/Sec 1 ) : 1972. The internal bushing shall be of either porcelain or

tough insulating material, like epoxy and shall have embedded stem. Metal portion of the internal HV bushing inside the tank shall remain dipped in oil in all operating conditions.

NOTE — Dimensions of internal bushings are under consideration.

### b) LV Bushing

Where provided, these shall be of porcelain.

### c) Connectors

Suitable bimetal connectors ( clamp type ) shall be provided on both HV and LV side for making sound terminations.

- d) The design of internal bushings shall be such as to provide adequate creepage distance in accordance with 7.1 of IS 2099 : 1986 and minimum clearance as given below:

	HV side		LV side	
	Inter- nal	Ex- ternal	Inter- nal	Ex- ternal
Phase to phase	127 mm	255 mm	45 mm	75 mm
Phase to earth	76 mm	140 mm	20 mm	40 mm

- e) The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.
- f) Gaskets shall be made of synthetic rubber or synthetic rubberised cork resistant to hot transformer oil.

## NOTES

- 1 Cork/natural rubber gaskets shall not be used.
- 2 Specific requirements and tests on synthetic rubber for the above purpose are under consideration.

## 13 MOUNTING ARRANGEMENT

**13.1** The under-base of all transformers shall be provided with two 75 × 40 mm channels 460 mm long as shown in Fig. 1 to make them suitable for fixing to a platform or plinth.

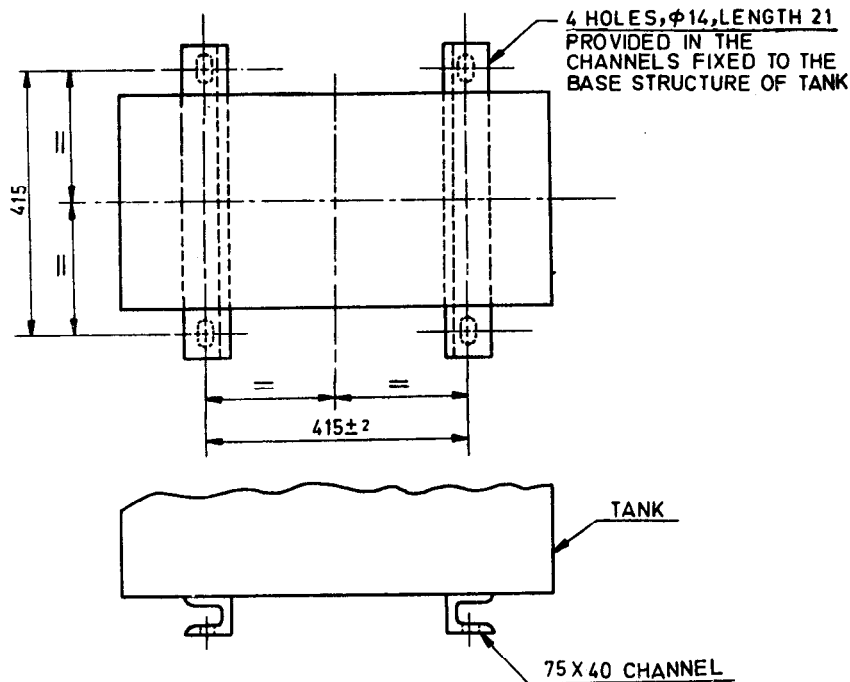
## 14 INSULATION LEVELS

**14.1** The transformer shall be capable of withstanding the power frequency and impulse test voltage for the appropriate voltage class as given in IS 2026 ( Part 3 ) : 1981.

## 15 LIMITS OF TEMPERATURE-RISE

**15.1** The temperature-rise shall not exceed the limits of 55°C (when measured by resistance method) for transformer windings and 45°C (measured by thermometer) in top oil when tested in accordance with IS 2026 ( Part 2 ) : 1977.

**15.2** The temperature correction for altitude shall be made in accordance with 3.3 of IS 2026 ( Part 2 ) : 1977.



All dimensions in millimetres.

FIG. 1 MOUNTING DIMENSIONS OF TRANSFORMER

## 16 LOSSES AND IMPEDANCE VALUES

### 16.1 Losses

The no load and load losses for aluminium wound transformers shall not exceed the values given below:

Rating kVA	No-Load Loss ( Fixed Loss ) W	Load Loss at 75°C° W
16	80	475
25	100	685
63	180	1 235
100	260	1 760

### 16.2 Impedance

The recommended impedance at 75°C is 4.5 percent.

## 17 TOLERANCES

17.1 The tolerance on electrical performance ( excluding losses ) shall be as given in 11 of IS 2026 ( Part 1 ) : 1977.

## 18 ABILITY OF TRANSFORMERS TO WITHSTAND EXTERNAL SHORT-CIRCUIT

18.1 The performance of transformer under external short-circuit conditions shall be in accordance with 8 and 9 of IS 2026 ( Part 1 ) : 1977.

## 19 MARKING

### 19.1 Rating Plate

Each transformer shall be provided with a non-detachable rating plate of weatherproof material, fitted in a visible, showing the information given in 15.2 of IS 2026 ( Part 1 ) : 1977. The entries on the rating plate shall be indelibly marked ( for example, by etching, engraving or stamping ).

## 20 INFORMATION REQUIRED WITH ENQUIRY AND ORDER

20.1 The information to be supplied to the manufacturer and the form of enquiry by the purchaser shall be in accordance with Annex B of IS 2026 ( Part 1 ) : 1977.

## 21 TESTS

### 21.1 General

The requirements given in 16.1 of IS 2026 ( Part 1 ) : 1977 shall apply.

21.2 All the tests listed under 21.3 and 21.4 shall be carried out in accordance with the provisions of the clauses and standards given in the parenthesis.



**21.3 Type Tests**

The following shall constitute the type tests:

- a) Measurement of winding resistance [ IS 2026 ( Part 1 ) : 1977 ],
- b) Measurement of voltage ratio and check of voltage vector relationship [ IS 2026 ( Part 1 ) : 1977 ],
- c) Measurement of impedance voltage/short-circuit impedance and load loss [ IS 2026 ( Part 1 ) : 1977 ],
- d) Measurement of no-load loss and current [ IS 2026 ( Part 1 ) : 1977 ],
- e) Measurement of insulation resistance [ IS 2026 ( Part 1 ) : 1977 ],
- f) Induced overvoltage withstand test [ IS 2026 ( Part 3 ) : 1981 ],
- g) Separate-source voltage withstand test [ IS 2026 ( Part 3 ) : 1981 ],
- h) Lightning impulse test [ IS 2026 ( Part 3 ) : 1981 ],
- j) Temperature-rise test [ IS 2026 ( Part 2 ) : 1977 ],
- k) Short-circuit test [ IS 2026 ( Part 1 ) : 1977 ],
- m) Air-pressure test ( 21.5.1 ), and
- n) Permissible flux density and overfluxing [ see 22.6 of IS 1180 ( Part 1 ) : 1981 ].

**21.4 Routine Tests**

The following shall constitute the routine tests:

- a) Measurement of winding resistance [ IS 2026 ( Part 1 ) : 1977 ],
- b) Measurement of voltage ratio and check of voltage vector relationship [ IS 2026 ( Part 1 ) : 1977 ],
- c) Measurement of impedance voltage/short circuit impedance and load loss [ IS 2026 ( Part 1 ) : 1977 ],
- d) Measurement of no-load loss and current [ IS 2026 ( Part 1 ) : 1977 ]

- e) Measurement of insulation resistance [ IS 2026 ( Part 1 ) : 1977 ],
- f) Induced overvoltage withstand test [ IS 2026 ( Part 3 ) : 1981 ],
- g) Separate-source voltage withstand test [ IS 2026 ( Part 3 ) : 1981 ], and
- h) Air pressure test ( 21.5.2 ).

**21.5 Air Pressure Test****21.5.1 Type Test**

The tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subjected to following pressure created inside the tank:

- a) 80 kPa above atmospheric pressure for 30 minutes, and
- b) A vacuum corresponding to — 70 kPa for 30 minutes.

**21.5.1.1 Requirement**

The permanent deflection of flat plate after pressure has been released shall not exceed the values given below:

Length of Plate	Deflection
Up to 750 mm	5 mm
751 to 1 250 mm	6 mm

**21.5.2 Routine Test**

The transformer with welded cover and with all fittings including bushings in position shall be tested at a pressure of 80 kPa above atmospheric pressure maintained inside the tank for 10 minutes.

**21.5.2.1 Requirement**

There should be no leakage at any joint.

NOTE — As the above test is required to be carried out before final sealing of the transformer, to witness this test, the inspecting authority would ensure to be present at the time of final sealing. The test cannot be demonstrated on a completed transformer.

## ANNEX A

### ( Clause 2.1 )

**LIST OF REFERRED INDIAN STANDARDS**

IS No.	Title	IS No.	Title
IS 2 : 1960	Rules for rounding off numerical values ( <i>revised</i> )	Part 2 : 1977	Temperature-rise ( <i>first revision</i> )
IS 335 : 1983	Specification for new insulating oils ( <i>third revision</i> )	Part 3 : 1977	Insulation level and dielectric test ( <i>second revision</i> )
IS 1180 ( Part 1 ) : 1989	Specification for out door type three-phase distribution transformers: Part 1 Non-sealed type ( <i>third revision</i> )	Part 4 : 1981	Terminal markings, tappings and connections ( <i>first revision</i> )
IS 1747 : 1972	Specification for nitrogen ( <i>first revision</i> )	IS 2099 : 1986	Specification for bushings for alternating voltages above 1 000 volts ( <i>second revision</i> )
IS 1885 ( Part 38 ) : 1977	Electrotechnical vocabulary: Part 38 Transformers ( <i>first revision</i> )	IS 3347 ( Part 3/Sec 1 ) : 1972	Dimensions for porcelain transformer bushings: Part 3 12 and 17.5 kV bushings, Section 1 Porcelain parts ( <i>first revision</i> )
IS 2026 ( in parts ) Part 1 : 1977	Specification for power transformers: General ( <i>first revision</i> )	IS 7421 : 1974	Specification for porcelain bushings for alternating voltages up to and including 1 000 volts

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